

Soils/Aggregate Field Proficiency 2013

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|----------------------------------|--|
| AASHTO T217-87 | Determination of Moisture in Soils by means of a Calcium Carbide Gas Pressure Moisture Tester |
| VTM - 12 | Use of One- Point Proctor Density |
| MARTCP Method SA- 1.3 | Percent Moisture Content Procedure |
| VTM-10 | Determining Percent of Moisture and Density Using the Nuclear Gauge |
| VTM-10 | Roller Pattern |
| VTM-10 | Control Strip |
| VTM-10 | Test Section |

SPEEDY MOISTURE TEST

Note to Examiner: Provide student with a complete speedy kit, No. 4 sieve, speedy chart, and sample of soil.

Trials

First Second

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Make sure moisture tester is clean and in good working order. Place three measures of calcium carbide and two steel balls in the large part of the moisture tester. Do not let the steel balls fall against the dial. (Sand can be used instead of calcium carbide for demonstration purposes.) |
| <input type="checkbox"/> | <input type="checkbox"/> | Sieve sample of soil through the No. 4 sieve. |
| <input type="checkbox"/> | <input type="checkbox"/> | Weigh soil sample on tared balance in kit and place in the cap. |
| <input type="checkbox"/> | <input type="checkbox"/> | Holding tester horizontally, insert cap and tighten clamps. |
| <input type="checkbox"/> | <input type="checkbox"/> | Holding tester vertically, tap top to allow soil to fall into large chamber. |
| <input type="checkbox"/> | <input type="checkbox"/> | Holding tester horizontally, rotate it so that the steel balls are put into orbit around the inside. |
| <input type="checkbox"/> | <input type="checkbox"/> | Rotate for 10 seconds, rest for 20 seconds. Repeat for a total of three (3) minutes. |
| <input type="checkbox"/> | <input type="checkbox"/> | Holding tester horizontally, read the pressure dial. Determine the moisture content of the soil from the speedy moisture chart by finding the dial reading and next to it reading the moisture content. |
| <input type="checkbox"/> | <input type="checkbox"/> | Carefully remove the cap making sure to point the instrument away from the operator to avoid breathing the fumes, and away from any potential source of ignition of acetylene gas. Empty the contents and examine the material for lumps. Examiner Ask Student: If sample is not completely pulverized what should be done? Repeat the test with a new sample. |

Note to Examiner: Point out the half sample weight to student and ask: What is this for and demonstrate how to use it.

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|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Student should state if the moisture content exceeds the limit of the pressure gauge (more than 20 on the dial) a half sample must be used. |
| <input type="checkbox"/> | <input type="checkbox"/> | Hang weight off balance. |
| <input type="checkbox"/> | <input type="checkbox"/> | Weigh out sample of soil. |
| <input type="checkbox"/> | <input type="checkbox"/> | Student can state all other steps are the same; except, double the dial reading before going to speedy chart. |

Note to Examiner: A score of 85% or better is required to pass.

13 Steps = 7.69 points each

Student misses two or more steps = failure

ONE POINT PROCTOR

Note to Examiner: Provide the student with the following: No. 4 sieve, proctor mold, 5.5 lb. drop hammer, beveled straightedge, knife, scales, scoop, TL-125A, and set of "Ohio Curves".

Trials

First Second

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|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: "What two pieces of information are you looking for with this test?" Maximum Dry Density & Optimum Moisture |
| <input type="checkbox"/> | <input type="checkbox"/> | Weigh the mold (without collar) and base plate and record. Attach collar. |
| <input type="checkbox"/> | <input type="checkbox"/> | Sieve a sample of soil through a No. 4 sieve. |
| <input type="checkbox"/> | <input type="checkbox"/> | Place mold on a stable surface Examiner Ask Student: What is a suitable surface? Concrete block weighing at least 200 lbs., concrete floor, concrete box culvert, bridge abutment. |
| <input type="checkbox"/> | <input type="checkbox"/> | Compact the soil into the Proctor mold in three approximately equal layers, compacting each layer 25 blows with the hand held 5.5 lb. drop hammer dropped 12 inches. Distribute the blows evenly around the surface of each layer. |
| <input type="checkbox"/> | <input type="checkbox"/> | Soil should be at least $\frac{1}{4}$ inch inside the collar when compaction is finished. Examiner Ask Student: What should you do if your sample is shy in the mold or you have too much? Start over. |
| <input type="checkbox"/> | <input type="checkbox"/> | Cut around edge of mold before collar is removed to prevent shearing. Examiner Ask Student: If sample shears below top of mold what would you do? Start over. |
| <input type="checkbox"/> | <input type="checkbox"/> | Remove the collar, and using a beveled straightedge strike off the surface evenly. |
| <input type="checkbox"/> | <input type="checkbox"/> | If surface voids are present, use soil trimmings to fill in and apply finger pressure. Trim the sample again. |
| <input type="checkbox"/> | <input type="checkbox"/> | Clean off the mold and base plate and weigh mold and base plate and wet sample. |
| <input type="checkbox"/> | <input type="checkbox"/> | Subtract empty weight from full weight and multiply by 30 (molds per ft ³) to determine the Wet Density. |
| <input type="checkbox"/> | <input type="checkbox"/> | Use a field hot plate or "Speedy" Moisture Test to determine Moisture Content. |
| <input type="checkbox"/> | <input type="checkbox"/> | Plot the wet density and moisture content on the "Ohio Curves" chart to determine the optimum moisture and maximum dry density. Student should indicate that the point should fall within "Moisture Limit Lines" on graph. Examiner Ask Student: What should you do if the point does not fall within "Moisture Limit Lines" on graph? If point falls to the right, let the soil dry out or start over and use less water. If the point falls to the left of moisture limit lines add more water. |

Note to Examiner: A score of 85% or better is required to pass.

13 Steps = 7.69 points each

Student fails last step = automatic failure

Student misses two or more steps = failure

FIELD MOISTURE CONTENT

Note to Examiner: Provide student with an electric hot plate or gas burner, scale, metal container, large spoon, and 1.1 lbs. (500 grams) of soil.

Note to Examiner: Student may verbally explain this procedure.

Trials **First Second**

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Student should state that 500 grams is the minimum sample required for soils and for aggregate the sample size depends on the Nominal Maximum Size Aggregate. |
| <input type="checkbox"/> | <input type="checkbox"/> | Weigh clean dry container and record weight. |
| <input type="checkbox"/> | <input type="checkbox"/> | Place sample in container and weigh. |
| <input type="checkbox"/> | <input type="checkbox"/> | Place container on stove or hot plate. Mix sample continuously to expedite drying. Use low flame or heat. |
| <input type="checkbox"/> | <input type="checkbox"/> | When sample looks dry, remove from stove, cool and weigh. |
| <input type="checkbox"/> | <input type="checkbox"/> | Place sample back on stove or hot plate. Continue to dry for 2 to 3 minutes. Cool and reweigh. |
| <input type="checkbox"/> | <input type="checkbox"/> | When constant weight is achieved, sample is dry. Record the weight. |
| <input type="checkbox"/> | <input type="checkbox"/> | To determine the moisture content $w, \% = \frac{(W \text{ wet} - W \text{ dry})}{(W \text{ dry} - W \text{ con})} \times 100$ |

Where:

w, % = percent moisture

w wet = weight of wet soil/aggregate and container

w dry = weight of dry soil/aggregate and container

w con = weight of container

Note to Examiner: A score of 85% or better is required to pass.

8 Steps = 12.5 points each

If student misses last step = automatic failure

If student misses two or more steps = failure

NUCLEAR TESTING

Note to Examiner: Student must be 18 years of age, able to lift 30 lbs., and must wear safety shoes and safety glasses. Provide student with nuclear gauge, reference block, drill rod guide, extraction tool, drill rod, hammer and safety glasses.

Trials
First Second

GAUGE WARM UP AND STANDARD COUNT PROCEDURE

- ☐ ☐ Wear TLD. Warm gauge up.
- ☐ ☐ Place reference block on flat surface. **Examiner Ask Student: What is minimum density and what distance should you be from any structure or any other radioactive device?** Minimum density of 100 lb/ft³ and 10 feet from any structure and 33 feet from any other radioactive source.
- ☐ ☐ Place gauge on reference block (seated flat, within raised edges, proper side of gauge against metal butt plate).
- ☐ ☐ Take Standard Counts.

DIRECT TRANSMISSION PROCEDURE

- ☐ ☐ Prepare a smooth flat test area free of surface voids.
- ☐ ☐ Place drill rod guide on test site. Insert drill rod through the extraction tool and into guide sleeve. Place foot on drill rod guide. Drive rod 2" deeper than depth of test. Carefully remove drill rod and drill rod guide.
- ☐ ☐ Select one minute count and soils mode on gauge.
- ☐ ☐ Place gauge over hole. Extend source rod into hole the required test depth. Source rod should not disturb hole.
- ☐ ☐ Gently pull on gauge housing so source rod is tight against hole. (Gauge flush on surface. Source rod locked in correct depth position.)
- ☐ ☐ Retract handle to safe position and record gauge readings.

Note to Examiner: A score of 85% or better is required to pass.
10 Steps = 10 points each
If student misses two or more steps = failure

ROLLER PATTERN

Equipment Needed to Actually Perform Roller Pattern: Nuclear gauge, reference block, drill rod guide/leveling plate, extraction tool, drill rod, hammer and compaction equipment that is typical for the rest of the project.

Note to Examiner: Student may take this test verbally. Examiner should state – Material to be tested is Aggregate Base Type I 21A. Student should complete gray areas on TL-53 to determine if test is acceptable.

Trials

First Second

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|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Gauge has been warmed up and standard counts have been taken. |
| <input type="checkbox"/> | <input type="checkbox"/> | 75 feet plus additional space to accommodate roller positioning (50 feet on each end). |
| <input type="checkbox"/> | <input type="checkbox"/> | Roller will make 2 passes (this varies) over the entire 75' section. Position gauge parallel with the roadway, with the source end toward the direction of the paver. Backscatter position in 15-second (fast) mode |
| <input type="checkbox"/> | <input type="checkbox"/> | Take 3 readings for density and moisture spread out over most of the 75' section and record on TL-53. Mark locations. Do not test any closer than 18 inches to an unsupported edge or in areas that have been overlapped (such as the center). |
| <input type="checkbox"/> | <input type="checkbox"/> | Record, add and average readings. Take 3 more readings for density and moisture in the same locations as before. Record, add and average readings. |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: How long would you continue this process? Continue until increase in dry density is less than 1 lb/ft ³ or until mat shows distress (cracking of aggregate). |

Give Student TL-53 to Complete

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner tell Student: Assume these are the readings you got. Show me where the increase in dry density was less than 1 lb/ft³. Student should indicate between Test 4 and 5. Examiner Ask Student: At this point what would you do? Cut vibrator off and make 1 additional pass to be certain there is a sufficient degree of compaction. Examiner Ask Student: What would you do if the dry density increases by more than 1 lb/ft³? Make one more pass with the roller. |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: How many passes did it take to reach Maximum Density? 10 Vibratory passes. |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: Is this an acceptable Roller Pattern? Yes. Each moisture falls within Optimum Moisture Range and the break is not over 1.5 lb/ft ³ . |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: When should a new roller pattern be established? When there is a change in: source of material, compaction equipment, gradation or type of material, or a visual change in subsurface or subgrade. |

Note to Examiner: A score of 85% or better is required to pass.

10 Steps = 10 points each

If student misses two or more steps = failure

CONTROL STRIP

Equipment Needed to Actually Perform Control Strip: Nuclear gauge, reference block, drill rod guide/leveling plate, extraction tool, drill rod, hammer and compaction equipment that is typical for the rest of the project.

Note to Examiner: Student may take this test verbally. Examiner should state – Material to be tested is Aggregate Base Type I 21A. Student should complete gray areas on TL-54 to determine if test is acceptable.

Trials

First Second

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|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Gauge has been warmed up and standard counts have been taken. |
| <input type="checkbox"/> | <input type="checkbox"/> | 300 feet plus additional space to accommodate roller positioning (50 feet on each end). |
| <input type="checkbox"/> | <input type="checkbox"/> | Backscatter position in 1-minute mode |
| <input type="checkbox"/> | <input type="checkbox"/> | Roller will make number of passes established by Roller Pattern over entire 300' section. Examiner Ask Student: How many passes will the roller make? (10 vibratory passes) |
| <input type="checkbox"/> | <input type="checkbox"/> | Take 10 readings for density and moisture spread out over most of the 300' section and record on TL-54. Test no closer than 18 inches to an unsupported edge. |

Give Student TL-54 to Complete

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|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner tell Student: Assume these are the readings. Add and average density readings. |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: Is this an acceptable Control Strip? Yes. All moisture readings fall within optimum moisture range and the average dry density is within 3 lb/ft ³ of the roller pattern's peak density. Examiner Ask Student: What would you do if the moisture content was not within ± 2 percentage points of optimum? Moisture below optimum moisture range – add water. Moisture above optimum moisture range - wait for it to dry out and retest that area. |
| <input type="checkbox"/> | <input type="checkbox"/> | Calculate individual dry density and average dry density requirements to be used for the test section. |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: What verification test is to be run next? A direct transmission test is to be run on aggregate and the density results compared to the theoretical maximum density (VTM-1). |

Note to Examiner: A score of 85% or better is required to pass.

9 Steps = 11.1 points each

If student misses 2 or more steps = failure

TEST SECTION

Equipment Needed to Actually Perform Test Section: Nuclear gauge, reference block, drill rod guide/leveling plate, extraction tool, drill rod, hammer and compaction equipment that is typical for the rest of the project.

Note to Examiner: Student may take this test verbally. Examiner should state – Material to be tested is Aggregate Base Type I 21A. Student should complete gray areas on TL-55 to determine if test is acceptable.

Trials

First Second

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Gauge has been warmed up and standard counts have been taken. |
| <input type="checkbox"/> | <input type="checkbox"/> | Half mile (2640 feet) per application width. |
| <input type="checkbox"/> | <input type="checkbox"/> | Backscatter position in 1-minute mode |
| <input type="checkbox"/> | <input type="checkbox"/> | Roller will make number of passes established by Roller Pattern and Control Strip over entire half-mile section. Examiner Ask Student: How many passes will the roller make? 10 vibratory passes |
| <input type="checkbox"/> | <input type="checkbox"/> | Take 5 readings for density and moisture spread out over most of the half-mile section and record on TL-55. Test no closer than 18 inches to an unsupported edge. |

Give Student TL-55 to Complete

- | | | |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner tell Student: Assume these are the readings. Add and average density readings. |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: Is this an acceptable test section? Yes. All moisture readings fall within optimum moisture range (3.3 – 7.3) and each individual dry density is at least 95% of the Control Strip Average Dry Density (128.5) and the average of the 5 dry density readings is at least 98% of the Control Strip Average Dry Density (132.6). |
| <input type="checkbox"/> | <input type="checkbox"/> | Examiner Ask Student: What would you do if test section readings were above or below the target values by more than 8 lb/ft ³ ? Establish a new control strip. |

Note to Examiner: A score of 85% or better is required to pass.
8 Steps = 12.5 points each
If student misses 2 or more steps = failure

MATERIALS DIVISION

REPORT OF NUCLEAR ROLLER PATTERN

English ☐Metric ☐Report No. 1-21A-1 Nuclear Gauge Model No. 3440 Serial No. 23456Date Today Route No. 95 Project No. 0095-029-F14,C502FHWA No. NH(95)-1 County FairfaxSection No. 1 Station 21+00 ft. (m.) to Station 21+75 ft. (m.)Type Material Aggregate Base Type I 21A Width 12 feet ft. (m.)Optimum Moisture 5.3 Optimum Moisture Range

Remarks:

1st lift 6" compacted depth, Roller Pattern No. 1, Vibratory Roller

STANDARD COUNTS

DENSITY 2847MOISTURE 695

| TEST NO. | DRY DENSITY | MOISTURE CONTENT | TEST NO. | DRY DENSITY | MOISTURE CONTENT |
|--------------------------------------|-------------|------------------|-----------------------------|-------------|------------------|
| Test No. 1 No.of Passes 2V | | | Test No.6 No.of Passes | | |
| Sta. 21+00 | 125.4 | 5.1 | Sta. 21+00 | 134.0 | 4.9 |
| Sta. 21+35 | 124.9 | 5.2 | Sta. 21+35 | 133.5 | 5.0 |
| Sta. 21+75 | 125.3 | 5.6 | Sta. 21+75 | 134.1 | 5.1 |
| Total Average | 375.6 | 15.9 | Total Average | 401.6 | 15.0 |
| Test No. 2 No.of Passes | | | Test No.7 No.of Passes | | |
| Sta. 21+00 | 128.4 | 5.4 | Sta. | | |
| Sta. 21+35 | 127.5 | 5.1 | Sta. | | |
| Sta. 21+75 | 128.5 | 4.9 | Sta. | | |
| Total Average | 384.4 | 15.4 | Total Average | | |
| Test No. 3 No.of Passes | | | Test No.8 No.of Passes | | |
| Sta. 21+00 | 131.8 | 5.1 | Sta. | | |
| Sta. 21+35 | 131.0 | 5.0 | Sta. | | |
| Sta. 21+75 | 132.1 | 4.9 | Sta. | | |
| Total Average | 394.9 | 15.0 | Total Average | | |
| Test No. 4 No.of Passes | | | Test No. 9 No.of Passes | | |
| Sta. 21+00 | 134.7 | 5.5 | Sta. | | |
| Sta. 21+35 | 133.7 | 4.9 | Sta. | | |
| Sta. 21+75 | 134.8 | 5.1 | Sta. | | |
| Total Average | 403.2 | 15.5 | Total Average | | |
| Test No. 5 No.of Passes | | | Test No. 10 No.of Passes | | |
| Sta. 21+00 | 135.5 | 5.2 | Sta. | | |
| Sta. 21+35 | 135.0 | 5.1 | Sta. | | |
| Sta. 21+75 | 135.4 | 4.9 | Sta. | | |
| Total Average | 405.9 | 15.2 | Total Average | | |

VIRGINIA DEPARTMENTS OF TRANSPORTATION
MATERIALS DIVISION
REPORT OF NUCLEAR CONTROL STRIP

English ☐ Metric ☐Report No. 1-21A-2Date TodayRoute 95Project No. 0095-029-F14,C502F.H.W.A. No. NH(95)-1County FairfaxType Material Aggr.Base Type I 21AWidth 12 feetStation 22+25 ft. (m.)to Station 25+25 ft. (m.)Nuclear Gauge Model No. 3440Serial No. 23456Remarks 1st lift 6" compacted depth, Roller Pattern No. 1

STANDARD COUNT

DENSITY
2847

MOISTURE
695

| | STATION | REFERENCE TO CENTER LINE ft. (m) | LANE | DRY DENSITY (lbs/ft ³) DRY UNIT MASS (kg/m ³) | MOISTURE CONTENT |
|----|---------|-------------------------------------|------|--|---------------------|
| 1 | 22+25 | 3' Rt. | WBL | 134.8 | 5.4 |
| 2 | 22+65 | 9' Rt. | WBL | 135.2 | 5.3 |
| 3 | 23+00 | 6' Rt. | WBL | 135.6 | 5.4 |
| 4 | 23+35 | 9' Rt. | WBL | 135.5 | 5.4 |
| 5 | 23+70 | 6' Rt. | WBL | 135.3 | 5.4 |
| 6 | 24+00 | 9' Rt. | WBL | 135.3 | 5.1 |
| 7 | 24+35 | 6' Rt. | WBL | 135.2 | 5.5 |
| 8 | 24+70 | 9' Rt. | WBL | 135.8 | 5.4 |
| 9 | 25+00 | 6' Rt. | WBL | 135.3 | 5.1 |
| 10 | 25+25 | 3' Rt. | WBL | 134.7 | 5.0 |
| | | | | TOTAL: 1352.7 | |
| | | | | AVERAGE: | |

5.3 OPTIMUM MOISTURE REQUIRED (From Producer or Materials Division)

 OPTIMUM MOISTURE RANGE

() x 0.95 =
Dens.Avg.

 INDIVIDUAL DRY DENSITY (lbs/ft³), DRY UNIT MASS (kg/m³)
REQUIREMENT FOR TEST SECTION

() x 0.98 =
Dens.Avg

 AVERAGE DRY DENSITY (lbs/ft³), DRY UNIT MASS (kg/m³)
REQUIREMENT FOR TEST SECTION

By
Title

Cc: District Materials Engineer
Project File

VIRGINIA DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION
REPORT OF NUCLEAR TEST SECTION

English ☐ Metric ☐
 Report No. 1-21A-4 Date Today
 Route No. 95 Project No. 0095-029-F14,C502
 FHWA No. NH(95)-1 County Fairfax
 Type Material 21-A Width 12 Feet
 Section No. 1 Station 25+25 ft (m.) to Station 51+65 ft (m.)
 Nuclear Gauge Model No. 3400 Serial No. 23456

Remarks First lift 6" compacted depth, Roller Pattern No. 1

| DENSITY | STANDARD COUNT | MOISTURE |
|-------------|----------------|------------|
| <u>2847</u> | | <u>695</u> |

5.3

OPTIMUM MOISTURE REQUIRED %
(from Producer or Materials Division)

OPTIMUM MOISTURE RANGE

INDIVIDUAL DRY DENSITY (lbs/ft³), DRY UNIT MASS (kg/m³) REQUIRED
(95% of Control Strip Dry Density from TL-54)

AVERAGE DRY DENSITY (lbs/ft³), DRY UNIT MASS (kg/m³) REQUIRED
(98% of Control Strip Dry Density from TL-54)

| TEST NO. | Station ft (m) | Lane | Dry Density (lbs/ft ³) Dry Unit Mass kg/m ³ | Moisture Content | (P) Pass (F) Fail |
|----------|----------------|------|---|---------------------|----------------------|
| 1 | 25+25 | WBL | 136.8 | 5.3 | |
| 2 | 29+25 | WBL | 135.0 | 5.4 | |
| 3 | 35+50 | WBL | 136.7 | 5.2 | |
| 4 | 43+00 | WBL | 133.2 | 5.3 | |
| 5 | 51+65 | WBL | 136.0 | 5.1 | |
| 6 | | | | | |

Total = 677.6

Comments:

CC: District Materials Engineer
Project File

By _____
Title _____